ASSOCIATION FOR PROMOTION OF MILLIMETER-WAVE
DEVELOPMENT AND UTILIZATION
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January 27,1995

Office of Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington,D.C. 20554

Re: ET Docket No . 94-124
RM-8308

DOCKET FILE COPY ORIGINAL

In the Matter of
Amendment of the Parts 2 and 15
of the Commission's Rules to permit
Use of Radio Frequencies Above 40 GHz
For New Radio Applications

Dear Secretary:

In compliance with your request ET Docket No . 94-124, we enclose the following documents.

"COMMENT FOR RECONSIDERATION OF VEHICULAR RADAR BANDS"
one(1) original and nine (9) copies

About a profile and the member of our association, please refer to appendix A and appendix B.
If additional information is required concerning this matter, please let us know.(Contact person is Mr. Masayoshi Wakao of RCR.)

For your information, we enclose "Japanese simple radio station system using 50GHz band", as appendix C.

Sincerely yours,

H. Kojima

Hiroshi Kojima
Secretary General

Enclosure

No. of Copies rec'd 0+9
List A B C D E

Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, D.C. 20554

In the matter of	)	
Amendment of Parts 2 and 15	)	
of the Commission's rules to Permit	)	ET Docket No. 94-124
Use of Radio Frequencies Above 40 GHz	)	RM-8308
for New Radio Applications	)	

COMMENT FOR RECONSIDERATION OF VEHICULAR RADAR BANDS

Hiroshi Kojima
Secretary General
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The Association for Promotion of Millimeter-Wave Development and Utilization[1] (APMDU) hereby proposes adding the 60-61 GHz band to the frequency bands proposed for vehicular radar use in the Federal Communications Commission's Notice of Proposed Rule Making[2] (NPRM).

As the Commission points out in this NPRM, the 59-64 GHz band has the most severe propagation losses. The range of use of vehicular radar is limited to a distance of around 100 m from a vehicle. Suitable propagation loss by a vehicular radar beam would be very effective in reducing potential interference to radar systems operating outside this range of use and to radio equipment used for other applications. For this reason, APMDU believes that the 59-64 GHz band is especially well-suited to vehicular radar use.

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[1]APMDU is an association that was established in Japan in November 1991 for the purpose of promoting the development and use of millimeter-wave systems. It consists of more than 80 companies and nonprofit foundations involved with the development or use of millimeter-wave technology.

[2]FCC 94-273, released November 8, 1994.

1. Introduction

With the sole exception of the frequency bands proposed for vehicular radar use, APMDU welcomes the Commission's proposal, as stated in FCC 94-273, to open for commercial use 18 GHz of spectrum in the millimeter-wave frequency bands above 40 GHz, which heretofore have been limited only to military and scientific applications in the United States. It is APMDU's view that this measure will promote the diffusion of millimeter-wave technology in the United States and the development of American industry.

It is believed that vehicular radar is one application that can be expected to stimulate the development and penetration of millimeter-wave technology and associated systems. In Japan, APMDU has been instrumental in promoting various studies of frequency band utilization as well as extensive discussions concerning the establishment of technical standards for vehicular radar.

The NPRM proposes that the entire 59-64 GHz band be allocated for use by unlicensed devices, inasmuch as this particular band has the most severe propagation losses and there would be minimal chance of interference. APMDU believes that this salient propagation characteristic should be used positively and preferentially for applications such as vehicular radar systems. Because the purpose, functions and conditions of use of vehicular radar systems are clearly known, the use of the 59-64 GHz band for these systems would definitely be effective and beneficial.

It is expected that vehicular radar will be extended to a variety of future uses, such as adaptive cruise control systems and route guidance systems, in addition to its use in warning systems. If the number of vehicles equipped with such systems increases in the future, it is inevitable that an important focus of concern will be the issue of how to eliminate the potential effects of interference effectively and at the lowest possible cost. In this respect, the 59-64 GHz band is optimally suited to vehicular radar use because, compared with other frequencies, it allows interference from distant radio wave sources to be minimized.

2. Recent Studies on Millimeter-Wave Use in Japan

A research study on millimeter-wave systems conducted by APMDU in 1992 indicated that vehicular radar was one key system that should be developed for future use. Accordingly, APMDU requested the Research and Development Center for Radio Systems (RCR), a private-sector responsible for establishing voluntary technical standards for radio systems in Japan, to undertake a study concerning the establishment of vehicular radar voluntary technical standards.

In response to this request, the RCR set up a committee concerning the development of vehicular radar. During 1992-1993, this committee conducted a study of related voluntary technical standards and drew up draft voluntary technical standards for vehicular radar systems. The draft voluntary technical standards propose the use of the 60 GHz band for vehicular radar and transmitter power of 10 mW.

A transmitter power level of 10 mW is one of the technical requirements for special low-power radio equipment in Japan. Special low-power radio equipment that has been certified as being in compliance with the relevant technical standards does not require a license and may be manufactured and marketed as radio gear.

The Telecommunications Technology Council, an advisory body to the Japanese Ministry of Posts and Telecommunications, is now conducting deliberations on technical standards that propose the allocation of the 59-64 GHz band for vehicular radar use.

In Japan, companies working on millimeter-wave technology and automobile manufacturers are currently developing 60 GHz millimeter-wave circuitry technology, including millimeter-wave integrated circuits (MMIC), as well as vehicular radar and systems that apply radar technology. Coordinated use of the same spectrum band in different countries would result in higher productivity, making it possible to supply millimeter-wave systems to consumers at minimum cost.

3. Discussion

3.1 Propagation characteristics of millimeter waves

It is well known that radio signals in the millimeter- wave spectrum are absorbed and attenuated by oxygen and water vapor during transmission in the atmosphere. Millimeter waves near 60 GHz in particular suffer large attenuation of 16 dB/km caused by oxygen molecules during transmission close to the earth's surface.[3] For this reason, millimeter-wave signals are not well suited to applications involving transmission over long distances.

On the other hand, large attenuation also offers the advantage that interference or crosstalk is less likely to occur even when there is highly concentrated use of frequencies within a certain area. This advantage has especially large significance for vehicular radar, in view of the fact that in the future there might be concentrated demand for frequency use by a large number of unspecified vehicles in a particular area.

3.2 Effect of reduced interference

Vehicular radar requires a maximum detection range of around 100 m. Atmospheric attenuation of the radar signal over a 100-meter distance is 1.6 dB at the most. That translates into round-trip attenuation of 3.2 dB, which is equivalent to approximately one-half of the transmitter power level. That amount of attenuation is well within allowable limits, compared with the received power of a radar system which declines in proportion to the fourth power of the distance involved. At this level of attenuation, it would be relatively easy to assure a satisfactory detection range, which is a major issue in vehicular radar system design.

It would also be possible to substantially reduce interference with the radar systems of distant vehicles. For example, the signal emitted by a radar-equipped vehicle at a distance of 600 m would show atmospheric attenuation alone of 9.6 dB. In other words, the signal would be attenuated to approximately one-tenth of the transmitter power. It is obvious that the amount of interference that would occur would differ depending on the extent to which radar beams were attenuated in the atmosphere during transmission from other cars approaching at a distance. Among the millimeter-wave frequencies under 100 GHz, noticeable atmospheric attenuation is a noteworthy characteristic that is only observed

[3] CCIR Rep. 719-3, Report of the CCIR, Annex to V, 1990.

around the 60 GHz band.

At the earth's surface (altitude of 0 km), signal attenuation caused by oxygen molecules shows a rather broad characteristic at frequencies around 60 GHz. The largest attenuation is seen in the 60-61 GHz band.[3]

3.3 Coexistence with NOAA's systems

The amount of atmospheric attenuation that occurs over an entire propagation path can be found by integrating the coefficient of atmospheric attenuation along the propagation path of interest. On propagation paths in the zenith direction, total signal attenuation caused by oxygen molecules ranges from 150 dB to more than 200 dB in the 60-61 GHz band.[3]

Consider a worst-case scenario in which the center of a vehicular radar beam is directed at a satellite located in the zenith direction. This would be the most severe condition, although it is virtually inconceivable that such a situation would ever occur. Assuming that the radar beam would be attenuated by at least 150 dB by atmospheric attenuation alone, radar transmitter power of 16 dBW EIRP.[4] (36dBi antenna, supplied power of 10mW) would be extraordinarily weak -- less than four-trillionths of a watt -- in relation to a satellite in outer space. If the satellite were in a position other than directly overhead, the power transmitted by a vehicular radar system would be even weaker because of the longer propagation path. Under ordinary conditions of use, a vehicular radar beam is transmitted parallel to the road surface. Since the propagation path would be far longer than that of the worst-case scenario, it is believed that any spurious emission toward outer space would be negligible.

Therefore, the use of the 60-61 GHz band by vehicular radar systems is not likely to cause any interference to NOAA's systems operating in the 60.4-61.2 GHz band, and vehicular radar can therefore coexist with the latter systems.

4. Proposal

As a modification of the frequency allocations proposed in the NPRM, APMDU proposes the addition of the 60-61 GHz band as frequencies for use by vehicular radar. The 60-61 GHz band poses no problems for short-range applications, and would be extremely effective in reducing possible interference, because signal attenuation due to oxygen absorption would increase with increasing distance from the detection area of a vehicular radar system. For these reasons, this frequency band is optimally suited to vehicular radar use.

5. Conclusion

Equipping vehicles with a sensing system such as radar for detecting the driving environment, similar to the use of radar on aircraft and vessels, will work to enhance their safety and convenience as a means of mobility.

The question of which allocated frequency bands are most suitable for vehicular radar use is a matter that will be determined by consumer preferences and marketplace

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[4]Effective Isotropically Radiated Power

mechanisms. When one considers the possibilities for the future development and diffusion of vehicular radar systems, it is important to select a frequency band that can minimize as much as possible any potential problems which might occur such as interference. APMDU believes that this point should be given full consideration in the present discussions concerning the allocation of frequency bands.

APPENDIX A

PROFILE OF APMDU

GROUP NAME	Association for Promotion of Millimeter-Wave Development and Utilization
OBJECTIVE	The objectives of the Association for Promotion of Millimeter-Wave Development and Utilization (APMDU) are to conduct investigation and research, collection of informations, communication and coordination with other organizations, enlightenment activities of all kind of related utilization system of millimeter wave from the viewpoint of promotion for development and utilization of millimeter wave. Thus, the APMDU aims at contribution to the wholesome advance of utilization of radio wave.
ACTIVITIES	1 Investigation and research of utilization system on millimeter wave 2 Collection of informations, exchange and publication regarding utilization system on millimeter wave 3 Communication and coordination with other organizations regarding utilization system on millimeter wave 4 Enlightenment and advertisement for spread promotoion of utilization system on millimeter wave
ESTABLISHMENT	Established by 76 members, on November 13, 1991
CHAIRMAN OF THE BOARD	VICE-CHAIRMAN VICARIOUS EXECUTION
VICE-CHAIRMAN	Yoshitaka Kurihara Adviser, Radio Equipment Technical Certification Institute
AUDITOR	Kenzoh Nukina Managing Director, The Sanwa Bank,Ltd..
SECRETARY GENERAL	Hiroshi Kojima Senior Managing Director, BROADCASTING TECHNOLOGY ASSOCIATION
SECRETARY	Hiroshi Furukawa Senior Managing Director, Research & Development Center for Radio Systems
SECRETARY	Hiroaki Shimayama Managing Director, NEC Corporation
SECRETARY	Jun Segawa Director, Nippon Telegrah and Telepone Corporation
SECRETARY	Junzoh Tsukamoto Director, JAPAN BROADCASTING CORPORATION
SECRETARY	Michio Fuzisaki Managing Director, FUJITSU LIMITED
SECRETARY	Tohru Hasegawa Senior Managing Director, Radio Equipment Technical Certification Institute

APPENDIX B

MEMBERS OF APMDU

ICOM INCORPORATED
ASAHI CHEMICAL INDUSTRY CO,,LTD.
AMTECHS CORPORATION
ALPINE ELECTRONICS INC.
ALPS ELECTRIC CO,,LTD.

ADVANTEST CORPORATION
Antenna Giken Co,,Ltd.
ANRITSU CORPORATION
IKEGAMI TSUSHINKI CO,,LTD.
ISUZU ADVANCED ENGINEERING CENTER,LTD.
Advanced Mobile Systems,Inc.
Mobile Radio Planning Corporation
Software Consultant Corporation
NTT Mobile Communications Network Inc.
OKI Electric Industry Company,Limited
KAJIMA CORPORATION
Calsonic Corp.
KANSEI CORPORATION
Clarion Co,,Ltd.
KENWOOD CORPORATION
KOKUSAI ELECTRIC CO,,LTD.
Kokusai Denshin Denwa Co,,Ltd
SAMSUNG JAPAN CORPORATION
SANYO ELECTRIC CO,,LTD.
The Sanwa Bank,Ltd.
Sanwa Research Institute Corp.
CSK Corporation
SPC ELECTRONICS CORPORATION
SHIMIZU CORPORATION
SHARP CORPORATION
JAPAN ENERGY CORPORATION
SUMITOMO ELECTRIC INDUSTRIES,LTD.
SEIKO EPSON CORP.
SECOM CO,,LTD.

Sony Corporation
TAISEI CORPORATION

TAKENAKA CORPORATION
DAIHEN Corporation
Chubu Telecommunication Company,Incorporated
RAILWAY TECHNICAL RESEARCH INSTITUTE
Denki Kogyo Co,,Ltd
Research & Development Center for Radio Systems
CENTRAL JAPAN RAILWAY COMPANY
TOKYO TELECOMMUNICATION NETWORK CO,,LTD.

TOSHIBA CORPORATION
Toyo Communication Equipment CO,,LTD.
TOYOTA MOTOR CORPORATION
TOYODA AUTOMATIC LOOM WORKS,LTD.
TOYOTA CENTRAL RESEARCH AND DEVELOPMENT LABORATORIES,INCORPORATED
NIKKO ELECTRIC INDUSTRY CO,,LTD.
NISSAN MOTOR CO,,LTD.
NISSAN DIESEL MOTOR CO,,LTD.
NIPPON ANTENA CO,,LTD.
Japan Satellite Systems Inc..
JAPAN TELECOM CO,,LTD.
NEC Corporation
NEC HOME ELECTRONICS,LTD.
NIHON DENGYO KOSAKU CO,,LTD.
Nippon Telegrah and Telepone Corporation
NIPPONDENSO CO,,LTD.
NIPPON PAINT CO,,LTD.
JAPAN BROADCASTING CORPORATION
Japan Radio Co,,Ltd.
NIPPON MOTOROLA LTD.
HAZAMA CORPORATION
EAST JAPAN RAILWAY CORPORATION
HITACHI CHEMICAL COMPANY
Hitach,Ltd.
Hitachi Denshi Ltd
Hino Motors,LTD.
FUJITSU LIMITED
FUJITSU TEN LIMITED
The Frukawa Electric Co,,Ltd.
BROADCASTING TECHNOLOGY ASSOCIATION
HONDA R&D CO,,LTD.
Matsushita Electric Industrial Co,,Ltd.
Matsushita electric Works,Ltd.
MATSUSHITA COMMUNICATION INDUSTRIAL CO,,LTD.
MITSUBISHI ELECTRIC CORPORATION
ADVANCED MILLIMETER WAVE TECHNOLOGIES CO,,LTD.
Radio Equipment Technical Certification Institute
MURATA MFG. CO,,LTD.
Meisei Electric Co,,Ltd.
YAGI ANTENA CO,,LTD.
YUPITERU INDUSTRIES CO,,LTD.
YOKOWO CO,,LTD.
Yokogawa Electric Corporation
ROBOTECH ENGINEERING CO,,LTD.
(88 MEMBERS, ON JANUARY 10,1995)

APPENDIX C

Japanese simple radio station system using 50GHz band

Since 1984, the simple radio station system using 50GHz band has been introduced for the purpose of promoting use of millimeter-wave systems in Japan.

1. Technical specification

Simple radio equipment must be operated under following specifications.

1)RF transmission power : less than 30mW
2)Antenna gain : less than 45dBi
3)Spurious emission : less than 100μW
4)Frequency stability : less than $\pm$200ppm
5)Occupied band-width : ①40MHz for TV signal and digital data exceed 6.3Mbps
②10MHz for other applications

Additionally, the simple radio equipment must satisfy following conditions.

6)Radio equipment except for antenna and power supplies must be mounted in a case and the case must be capable of being opened without difficulty.
7)Radio equipment must be provided with an automatic control facility that prevents the occupied band width from exceeding the regulated value.

2. Radio channel allocation

In case of TV signal or digital data with transmission rate greater than 6.3M bps, 5 RF channels are provided in the frequency band from 50.44GHz to 51.10GHz.

	Transmit frequency	Receive frequency
CH 1	50.44GHz	50.94GHz
CH 2	50.48GHz	50.98GHz
CH 3	50.52GHz	51.02GHz
CH 4	50.56GHz	51.06GHz
CH 5	50.60GHz	51.10GHz

19 RF channels are provided in the frequency band from 50.44GHz to 51.12GHz for other applications.

	Transmit frequency	Receive frequency
CH 1	50.44GHz	50.94GHz
CH 2	50.45GHz	50.95GHz
....	....	....
CH19	50.62GHz	51.12GHz

3. Applications

Applications of simple radio station system using 50GHz are divided roughly into three fields, i.e. remote monitoring, video transmission and voice/data transmission.

3.1. Remote monitoring

Remote monitoring systems usually have monitoring cameras, remote camera control, alarm/warning and an orderwire. Radio systems are most suitable for remote monitoring, temporary use for event, use in case of difficulty of laying cable and saving labor.

The propagation path length in these fields is less than 10km usually.

3.2. Video transmission

Video transmission systems ordinarily require a two-way color motion video transmission ability and two-way voice transmission ability. The propagation distance is usually up to 10km.

Examples of applications are shown below.

1)Inter-building TV conference
ex) urgent meeting, blueprint reference, article check

2)Inter-building remote lecture
ex) connecting schoolhouses dispersed in a building site
3)Self-supporting TV broadcasting
ex) connecting dispersing institutes of enterprise, hotel, store/shop, school, organization
4)Event relay system
ex) gathering audio/video data at field and transmitting to private broadcasting station

3.3. Voice/data transmission

General requirements for private data communications network are multiplexing and transmitting functions of voice and data signals, and connecting/transmitting LAN traffic etc. In this case the propagation path length should be less than 3km because of the importance of maintaining data signal integrity.

Examples of applications are shown below.

1) Extension of PBX lines (voice only)
2) Inter-PBX transmission (voice only)
3) Self-supporting private data line (voice and data)
4) Inter-LAN connection (data only)